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Haltevorrichtung für Substratscheiben

Dispositif de fixation pour plaquettes de substrats

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(56) References cited:
EP-A- 0 016 579
EP-A- 0 045 057
EP-A- 0 198 501

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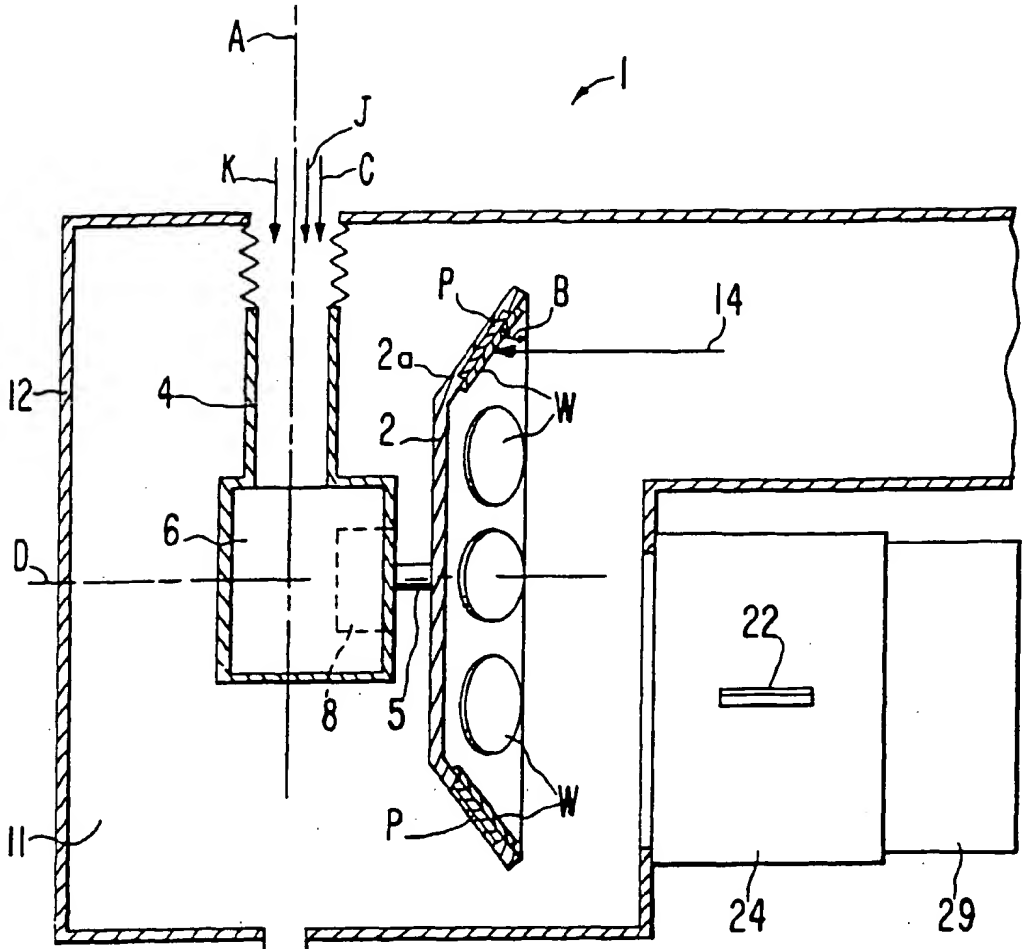
FIG. 1


A
1
J
K
C
P
B
14
2a
W
12
4
2
6
D
22
8
5
W
P
11
24
29
9
7
VACUUM
PUMP

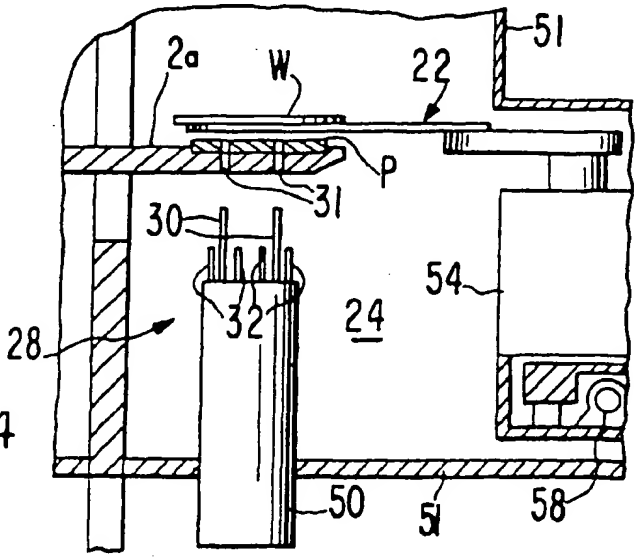

51
2a
W
22
P
31
30
54
32
24
28
50
58

FIG. 4

FIG.2

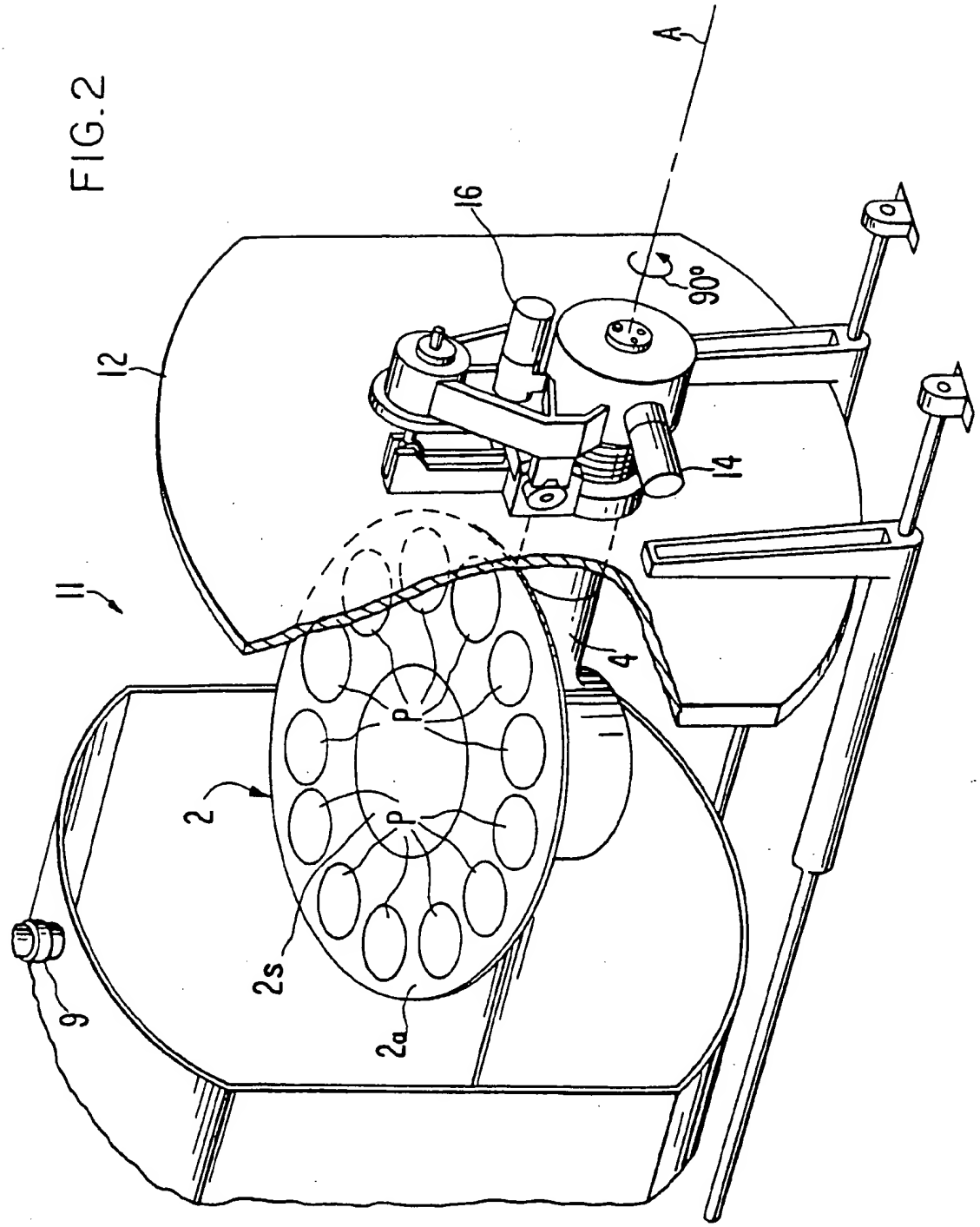


FIG.3

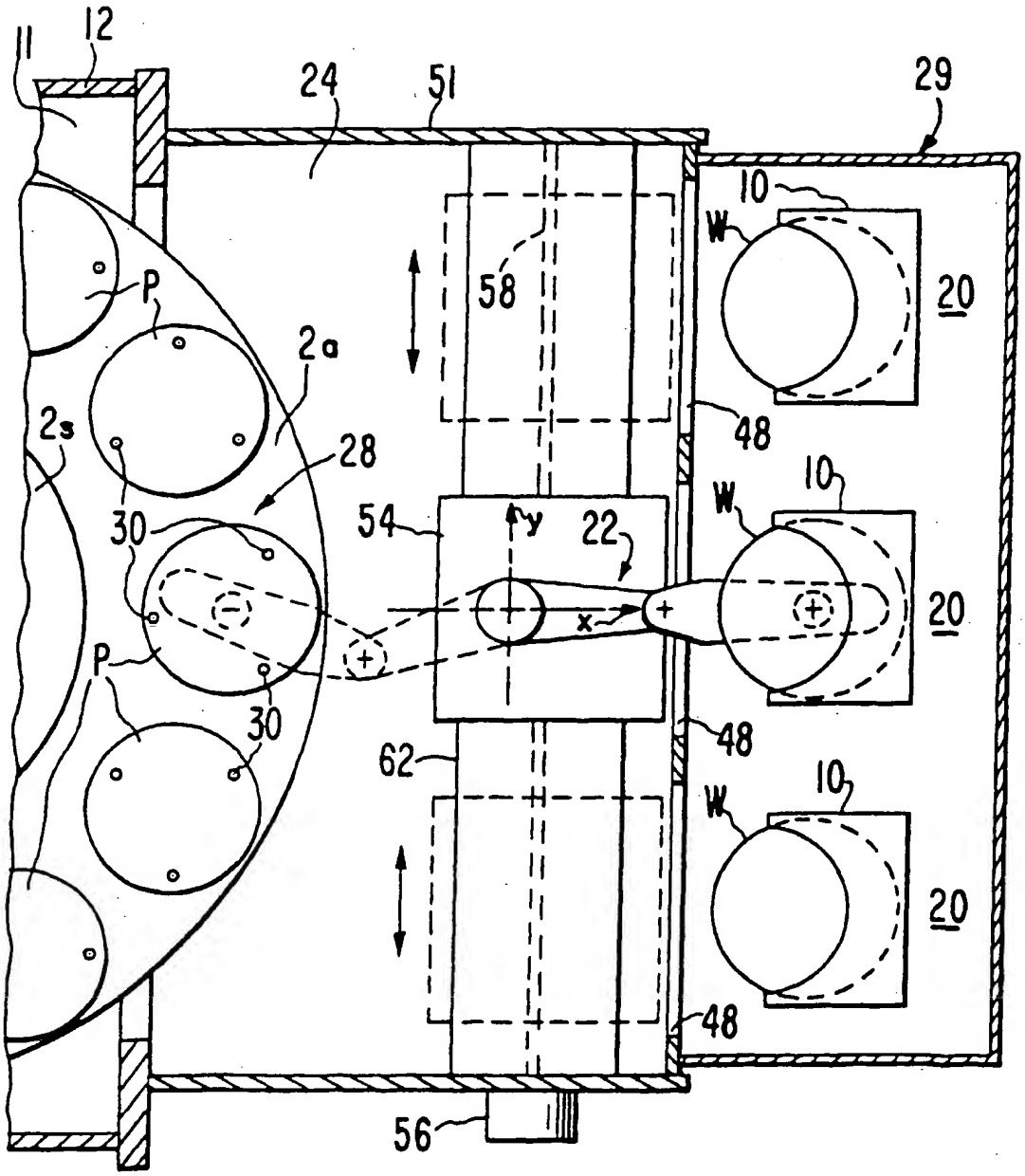
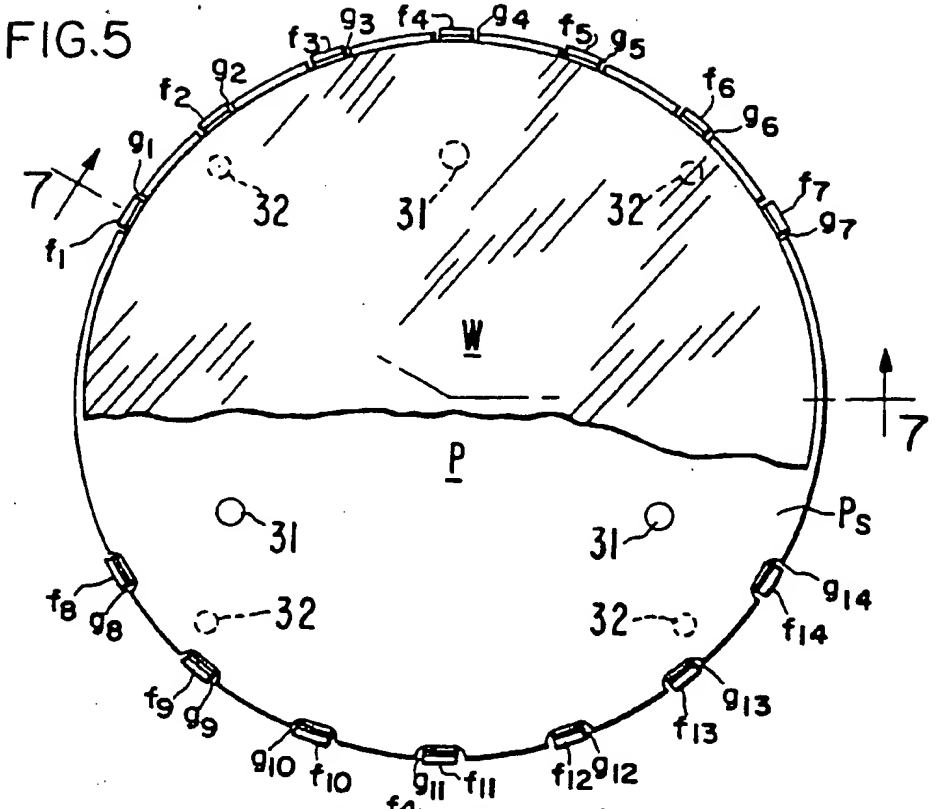


FIG.5


f1
g1
f2
g2
f3
g3
f4
g4
f5
g5
f6
g6
f7
g7
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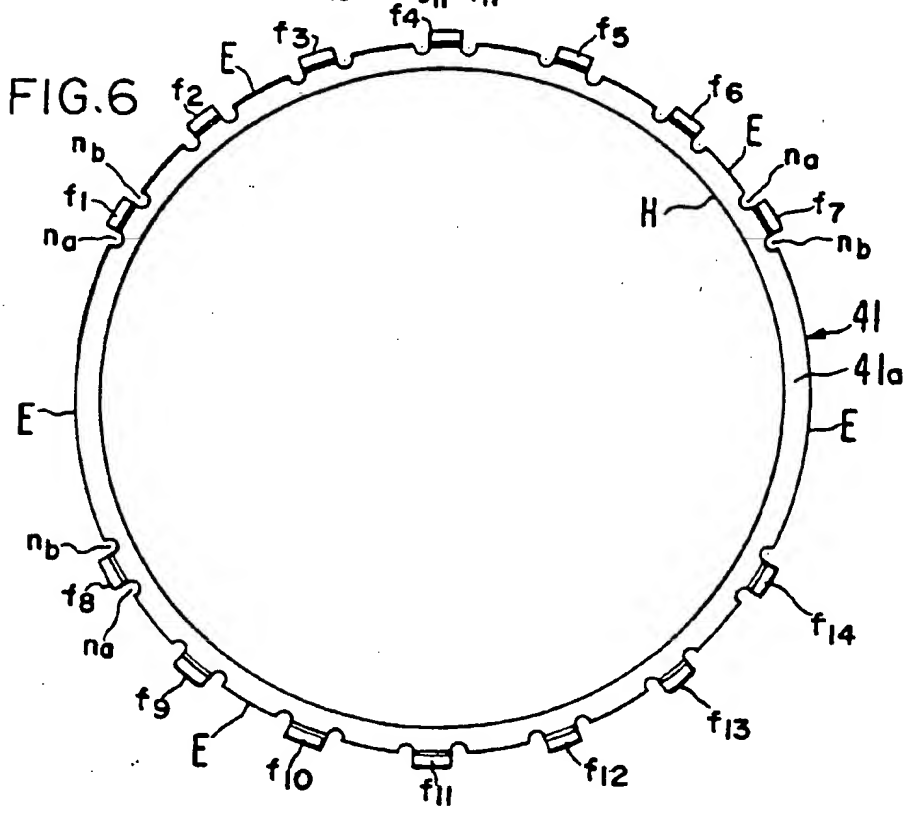
g8
f9
g9
f10
g10
f11
g11
f12
g12
f13
g13
f14
g14
7
7
32
31
32
W
P
31
31
32
32
Ps

FIG.6


f1
f2
f3
f4
f5
f6
f7
f8
f9
f10
f11
f12
f13
f14
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E
E
E
E
E
na
nb
na
nb
na
nb
H
41
41a

FIG.7

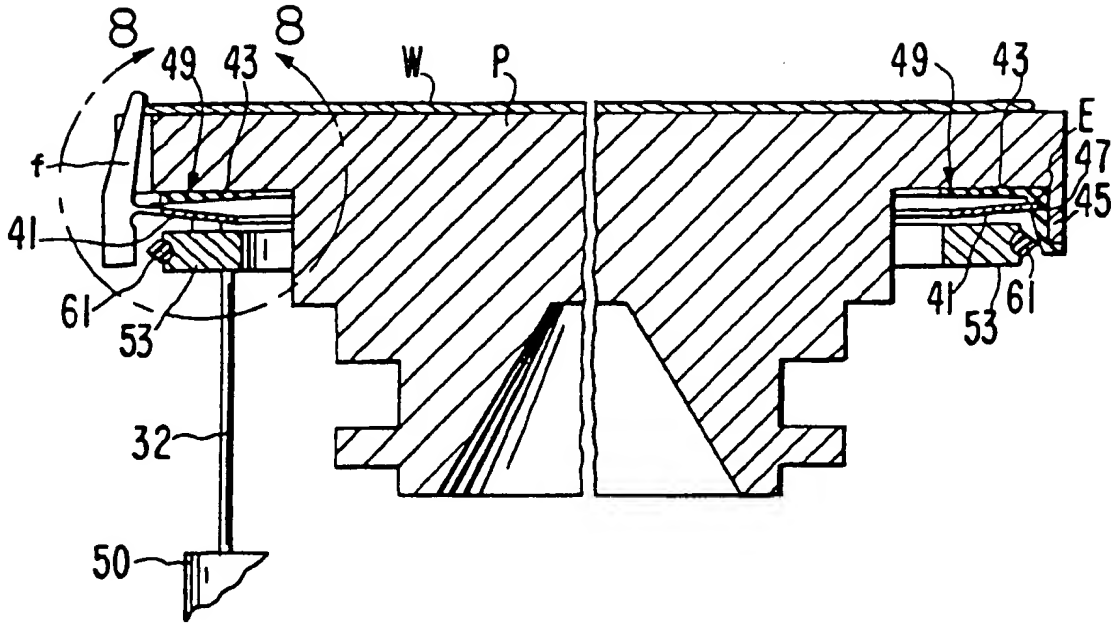
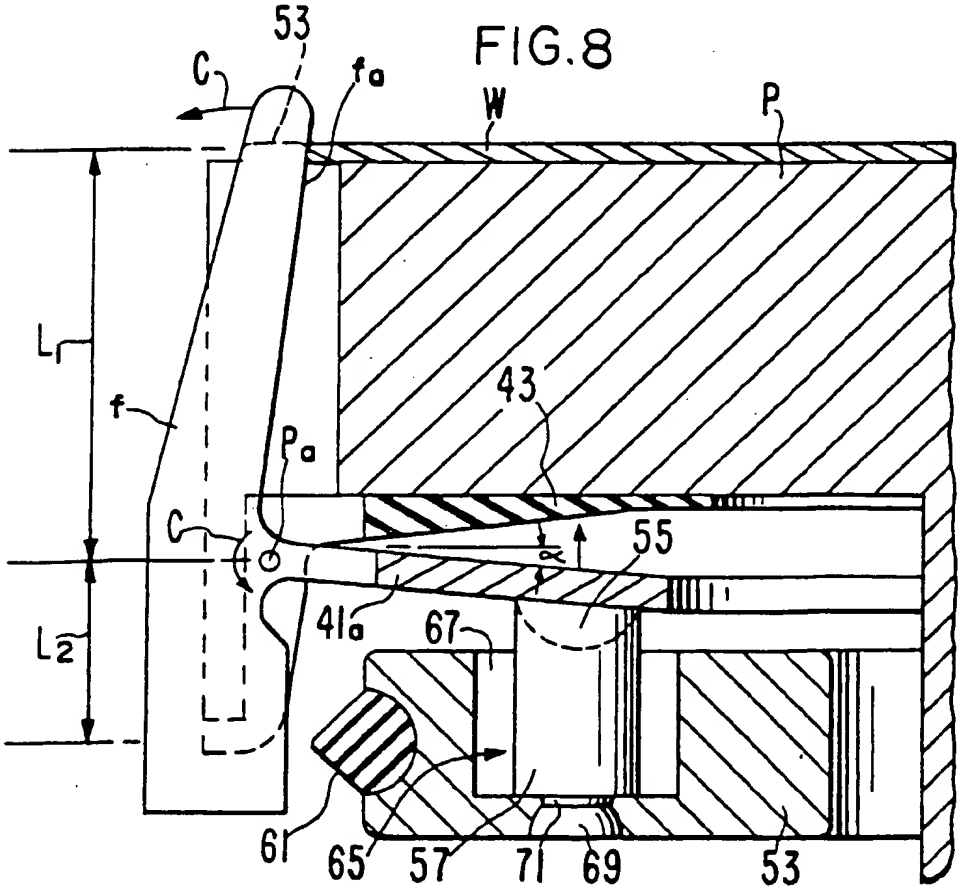

8
8
49
43
W
P
49
43
E
47
45
f
41
61
53
41
61
53
32
50

FIG.8


53
C
fa
W
P
L1
f
43
Pa
C
55
α
41a
67
L2
61
65
57
71
69
53

f is dimensioned so that it extends only to the top surface of wafer W. The phantom line 53 in FIG. 8 indicates the contour of a finger f which does not extend above the surface of wafer W. This contour is advantageous for reducing the sputter of the wafer surface caused by energetic ions striking fingers f.

It should also be noted that inside face, f_a of finger f is angled at a few degrees, typically 3-4°, from the normal to the flat surface of platen P. This provides a good contact with the semicircular edge of a typical wafer and provides a small component of the force of finger f pressing against wafer W normal to platen P, which also tends to hold wafer W on platen P. In the embodiment shown in FIG. 8, the inside face f_a is also curved (in a plane perpendicular to the plane of FIG. 8) to match the curved circumferential edge of the wafer, thus spreading the load and reducing stress on the wafer. Finger f is also slightly tapered to reduce mass. In one embodiment (not shown) the inside surface f_a is coated with PTFE or other suitable material to prevent wafer W from contacting the metal of finger f, thus reducing particle generation and improving the grip of finger f.

The apparatus described above for releasably retaining a wafer on a platen has several other advantages over prior art clamping devices.

No surface area of the wafer W is contacted by the wafer retaining apparatus, so that all of the surface area of the wafer is available for the production of semiconductor devices.

Since the wafer is lowered vertically onto the platen and then held there by the retaining fingers, wafer sliding against the platen, which may cause contamination by generating particulates, is virtually eliminated. None of the moving parts of the apparatus slide or rub against the wafer.

All metal parts of the wafer retaining apparatus snap together by means of elastomeric interfaces, eliminating metal to metal contact, which generates particles, and also eliminating metal fasteners such as screws. In general, assuming at least 3 fingers contacting the wafer along an arc greater than 180°, the sum of the forces on the wafer exerted by the fingers (and vice-versa) is independent of the number of fingers contacting the edge of the wafer. Thus, by increasing the number of fingers, the force exerted by each finger on the wafer is reduced, which reduces wafer breakage. If a finger is positioned opposite a wafer flat, the holding device remains in equilibrium.

Finally, the design is intrinsically safe. Wafer W will be retained on the rotating platens for the duration of the implant process even if the spring portion of the collet breaks or if the counterweight ring 53 is no longer retained by elastomeric projections 57.

For example, resilient member 41a in FIG. 8 is in the shape of a continuous generally annular ring angled slightly downward from outer edge to inner edge, in other embodiments the resilient member may be given other shapes to better accommodate the shape of the workpiece. For example, the resilient member 41a may be an oval loop or square loop. In the embodiment shown, the resilient member 41 forms a simple closed loop; but if desired, the resilient member may comprise more than one disjoint resilient section, each section connecting a plurality of fingers, with a separate means for selectively elastically deforming each resilient section to move the fingers attached thereto into and out of engagement with a workpiece. It should also be clear that the invention may be used for releaseably retaining any workpiece and that the workpiece need not be shaped like a disk. The invention may also be employed to retain wafers in conjunction with many different semiconductor processes in addition to ion implantation.

Claims

1. A device for releasably holding a workpiece, said device comprising:

   a base formed of a platen (P) having a flat upper surface (P_s) for supporting a workpiece W;
   a resilient member (41) positioned below said base and having a plurality of finger members (f_1-f_{14}) extending therefrom so as to extend slightly above said upper surface of said base; and
   means for selectively moving said finger members into and out of engagement with a workpiece positioned on said flat upper surface, said means for moving including moving means (50, 32, 53) for elastically deforming said resilient member to move said finger members; wherein the resilient member comprises a generally conical resilient annular ring portion (41a), said finger members being attached to the periphery of said ring portion and extending therefrom for engagement with the peripheral edge of a workpiece positioned on said flat upper surface of the platen; and
   said moving means (50, 32, 53) comprises:
   a counterweight ring member (53) situated below and attached to said resilient member; and
   driving means (50, 32) for driving said counterweight ring member against said resilient ring portion (41a) so as to elastically deform said resilient ring portion (41a) and cause pivoting of said finger members (f_1-f_{14}) about the point (P_a) of attachment of said fingers to said resilient member.

2. A device as claimed in claim 1 wherein said finger members (f_1-f_{14}) are coated with a material selected to reduce particle generation.

3. A device as claimed in claim 1 wherein said finger members (f_1-f_{14}) are coated with a material selected

to improve the grip of said fingers.

4. A device as claimed in any one of claims 1 to 3 wherein said finger members (f_1-f_{14}) have an inner surface (f_a) for contacting said workpiece inclined a few degrees relative to the normal to said flat surface of said platen.

5. A device as claimed in claim 4 wherein said fingers have a portion of said inner surface which is curved.

6. A device as claimed in claim 5 in combination with a disc shaped flat workpiece, the curved inner surface of said fingers being selected to match the outer peripheral edge of said flat workpiece.

7. A device as claimed in any one of claims 1 to 6 wherein said platen possesses a plurality of openings (31) extending from the flat surface of said platen through said platen, and further including means (50) for extending a corresponding plurality of lifting members (30) through said openings above said flat surface for lifting a flat workpiece from said platen and for retracting said plurality of said lifting members through said openings to a position beneath said surface for lowering a flat workpiece onto said platen.

8. A device as claimed in any one of the preceding claims wherein the finger members can be moved to engage the peripheral edge of the workpiece without contacting or extending over the flat surface of the workpiece.

9. A device as claimed in any one of claims 1 to 7 further comprising:

   means (43, P_a) for pivotally attaching said resilient member to said base;
   said driving means being adapted to pivot said finger members from a first position to a second position for engaging the peripheral edge of the workpiece to hold the workpiece against the flat surface of the platen without contacting or extending over the flat surface of the workpiece.

10. A device as claimed in claim 9 wherein said means for pivotally attaching comprises an elastomeric member (43) positioned between said platen and said resilient member.

11. A device as claimed in claim 10 wherein said elastomeric member is attached to said platen.

12. A device as claimed in claim 10 or claim 11 wherein said elastomeric member possesses a groove (47) for receiving an edge of said resilient member.

Patentansprüche

1. Vorrichtung zum lösbaren Halten eines Werkstücks mit:

   einer Basis, die aus einem Träger (P) mit einer flachen, oberen Oberfläche (P_s) zum Tragen eines Werkstücks W gebildet ist;
   einem elastischen Element (41), das unter der Basis angeordnet ist und eine Mehrzahl von sich von dieser erstreckenden Finger-Elementen (f_1-f_{14}) aufweist, um sich über die obere Oberfläche der Basis zu erstrecken; und
   Mitteln zum wahlweisen Bewegen der Finger-Elemente in und aus einem Eingriff mit einem an der flachen, oberen Oberfläche angeordneten Werkstück, wobei die Mittel zum Bewegen Bewegungs-Mittel (50, 32, 53) aufweisen zum elastischen Verformen des elastischen Elements, um die Finger-Elemente zu bewegen;
   wobei das elastische Element einen im wesentlichen konischen, elastischen, ringförmigen Ringabschnitt (41a) aufweist und die Finger-Elemente an dem Umfang des Ringabschnitts befestigt sind und sich von diesem erstrecken für einen Eingriff mit dem Umfangsrand eines Werkstücks, das an der flachen, oberen Oberfläche des Trägers angeordnet ist; und
   wobei die Bewegungs-Mittel (50, 32, 53) aufweisen:

      ein Gegengewichts-Ringelement (53), das unterhalb von dem elastischen Element angeordnet und an diesem befestigt ist; und
      Antriebs-Mittel (50, 32) zum Bewegen des Gegengewichts-Ringelements gegen den elastischen Ringabschnitt (41a), um den elastischen Ringabschnitt (41a) elastisch zu verformen und ein Schwenken der Fingerelemente (f_1-f_{14}) um den Befestigungspunkt (P_a) der Finger-Elemente an dem elasti schen Element zu verursachen.

2. Vorrichtung nach Anspruch 1,
   dadurch gekennzeichnet, daß die Fingerelemente (f_1-f_{14}) beschichtet sind mit einem Material, das ausgewählt ist, um eine Partikelerzeugung zu reduzieren.

3. Vorrichtung nach Anspruch 1,
   dadurch gekennzeichnet, daß die Fingerelemente (f_1-f_{14}) beschichtet sind mit einem Material, das ausgewählt ist, um den Griff der Fingerelemente zu verbessern.

4. Vorrichtung nach mindestens einem der Ansprüche 1 bis 3,